

# Functions of biological membranes

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☼ Status	Done
☰ Chapter	Cell - The Unit of Life    Membrane Structure and Function Physical Structure of a cell
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## Compartmentalization

- Membranes are continuous, unbroken sheets and, as such, inevitably enclose compartments.

- The plasma membrane encloses the contents of the entire cell, whereas the nuclear membrane enclose nucleus and other membranes enclose diverse intracellular spaces.
- Specialized activities to proceed without external interference and enables cellular activities to be regulated independently of one another.
- Eg- Acid Hydrolases

## **Scaffold for biochemical activities**

- Membranes not only enclose compartments but are also a distinct compartment themselves.
- why membranes are important for biochemical processes ?
- If reactions were having happening or occurring randomly in solution and the positions of those reactions could not be stabilized or controlled the interactions of the enzymes and their substrates would be dependent on random collisions this would create a very inefficient process.
- For reactants floating around in solution, their interactions are dependent on random collisions. In contrast, components that are embedded in a membrane are no longer floating free and can be ordered for effective interaction.
- If you're trying to control the catalyzer biochemical pathway so biological membranes or plasma membranes actually circumvent this problem by providing a cell fixed positions for effective interactions.
- Example: the electron transport chain or components of the electron transport chain actively using the energy that is released from redox reactions oxidation reduction reactions to drive the creation of a proton gradient in the intermembrane space, the space between the inner and the outer mitochondrial membrane now another enzyme called ATP synthase and comes along and uses that established concentration gradient that gradient of protons to drive the production of ATP .This is a very key example of scaffolding where the enzymes involved in a series of biochemical reactions neatly or uniquely arranged in the plasma membrane to allow them to more efficiently perform their function.
- Scaffolds, typically made of polymeric biomaterials, provide the structural support for cell attachment and subsequent desired resultant development.

# Providing a selectively permeable barrier

- Membranes prevent the unrestricted exchange of molecules from one side to the other. At the same time, membranes provide the means of communication between the compartments they separate.
- Have gated “bridges” that promote the movement of select elements into and out of the enclosed living space.

# Transporting solutes

- The plasma membrane contains the machinery for physically transporting substances from one side of the membrane to another, often from a region where the solute is present at low concentration into a region where that solute is present at much higher concentration.
  - The membrane’s transport machinery allows a cell to accumulate substances, such as sugars and amino acids, that are necessary to fuel its metabolism and build its macromolecules.
  - The plasma membrane is also able to transport specific ions, thereby establishing ionic gradients across itself i.e. **Electrochemical gradient**. This capability is especially critical for nerve and muscle cells.
  - In resting state, Nerve cell are in polarised state.
- ▼ Why can't a living cell reach metabolic equilibrium?
- In short: a cell that's reached metabolic equilibrium is presumed dead.
  - Cells are not in a state of equilibrium, they are dynamic entities and are thermodynamically far from equilibrium (except when they are dead).
  - In the resting state they are in a local energy minimum (“steady state”) on the free energy landscape but that can change at any time.

# Signal transduction : Responding to external stimuli

- The plasma membrane plays a critical role in the response of a cell to external stimuli, a process known as **signal transduction** .

- Membranes possess receptors that combine with specific molecules (ligands ) or respond to other types of stimuli such as light or mechanical tension.
- Different types of cells have membranes with different receptors and are, therefore, capable of recognizing and responding to different environmental stimuli.

## Intercellular interaction

- The plasma membrane allows cells to recognize and signal one another, to adhere when appropriate, and to exchange materials and information.
- Proteins within the plasma membrane may also facilitate the interaction between extracellular materials and the intracellular cytoskeleton.

## Energy transduction

- Membranes are intimately involved in the processes by which one type of energy is converted to another type (**energy transduction**).
- Example- Photosynthesis when energy in sunlight is absorbed by membranebound pigments, converted into chemical energy, and stored in carbohydrates.
- Membranes are also involved in the transfer of chemical energy from carbohydrates and fats to ATP. In eukaryotes, the machinery for these energy conversions is contained within membranes of chloroplasts and mitochondria.

## Summarize and Most important to atleast remember

Membranes in cells serve several important functions.

- First, they compartmentalize the cell into distinct regions, allowing for specialized activities to proceed without external interference and for cellular activities to be regulated independently of one another.
- Second, membranes serve as scaffolds for biochemical activities, allowing for the ordered and effective interaction of enzymes and their substrates.
- Third, membranes provide a selectively permeable barrier, preventing the unrestricted exchange of molecules from one side to the other while promoting

the movement of select elements.

- Fourth, the plasma membrane contains the machinery for physically transporting substances from one side of the membrane to another, establishing ionic gradients across itself, critical for nerve and muscle cells.
- Fifth, membranes play a critical role in the response of a cell to external stimuli, known as signal transduction, allowing cells to recognize and respond to different environmental stimuli.
- Sixth, the plasma membrane allows cells to recognize and signal one another, to adhere when appropriate, and to exchange materials and information.
- Finally, membranes are intimately involved in the processes by which one type of energy is converted to another type, such as in photosynthesis and the transfer of chemical energy to ATP.